

REFRIGERATION APPLIANCE

Field of the Invention

The present invention refers to a refrigeration appliance in the form of a refrigerator presenting a thermally insulated cabinet, in which the user can provide, in different numbers, dimensions and positionings, refrigerating and freezing compartments operating in respective temperatures levels which are adequate to the functions thereof.

10 Prior Art

There are well known from the prior art the constructive arrangements applied to refrigerating cabinets so as to provide them with multiple functions. An example of these refrigerating cabinets can be found in the combined refrigerators, in which the cabinet defines at least one refrigerating compartment and one freezing compartment, which are frontally closed by respective doors. While the market has been provided with different models of simple or combined refrigerators and freezers, in which the relative positioning of the compartments is particular and specific for each different model, it has not been possible up to now to obtain a refrigeration appliance of the type considered herein, which allows the user to modify the arrangement and the internal characteristics of the refrigerating and freezing compartments, adjusting them volumetrically and in physical arrangement along the height of the appliance cabinet as a function of the operational needs of each user, even when these operational needs vary along the time of use of the refrigeration appliance.

The efforts for providing a certain mounting versatility for varying the characteristics of the different inner compartments of the cabinet have not succeeded, as they are limited to the simplification

of the constructive process, which allows only the manufacturer to modify the model of the product to be delivered or offered to the user, who is prevented from varying, according to his/her needs, the constructive arrangement of the inner compartments of the refrigeration appliance.

Objects of the Invention

As a function of the limitations imposed by the constructive solutions known heretofore, it is an object of the present invention to provide a refrigeration appliance of the type considered herein, which allows the user to modify the volumetric relationship and the physical arrangement of the refrigerating and freezing compartments formed in the interior of the cabinet of the refrigeration appliance, supplying to each type of formed compartment the refrigerated air flow in the conditions required for obtaining the desired operational temperature.

It is a further object of the present invention to provide a refrigeration appliance as mentioned above, which can have the interior of its cabinet divided in different manners in one or more refrigerating and freezing compartments in a modular arrangement.

Summary of the Invention

Aiming at attaining the objects mentioned above, the present invention provides a refrigeration appliance comprising: a cabinet which defines a refrigerating compartment provided with at least one front door and an air refrigerating chamber. Inside the cabinet are provided refrigerating and freezing air supply ducts, each duct having an inlet opening in communication with the air refrigerating chamber and a plurality of outlet openings in communication with the refrigerating compartment, each outlet opening being

provided with a valve which is operated to provide the closing and the selective opening of said outlet opening to the interior of the respective compartment.

There are further provided in the cabinet
5 refrigerating and freezing air return ducts, each duct having at least one inlet window opened to the interior of the cabinet and an outlet window opened to the air refrigerating chamber.

There is provided inside the air refrigerating chamber
10 at least one evaporator and one fan, the latter producing a forced air flow that is refrigerated through the evaporator and blown into the refrigerating and freezing air supply ducts, so as to be conducted to the interior of the compartment
15 desired to be refrigerated.

Inside the cabinet at least one freezing compartment can be optionally assembled, provided with a front door and occupying a determined portion of the inner volume of the refrigerating compartment and in
20 communication with at least one outlet opening of a freezing air supply duct and with at least one inlet window of a freezing air return duct leading to the air refrigerating chamber.

In a preferred constructive form, the freezing
25 compartment, on being mounted within the cabinet, blocks any outlet opening belonging to a respective refrigerating air supply duct and which is directed to the region of the cabinet occupied by said freezing compartment.

The construction defined above allows the user to
30 mount, according to his/her needs and to a modular arrangement, none, one, or several freezing compartments inside the cabinet, maintaining the non-occupied regions, if present, each operating as a
35 refrigerating compartment and the occupied regions

operating as freezing compartments.

Brief Description of the Drawings

The invention will be described below with reference to the enclosed drawings, given by way of example of possible embodiments of the invention and in which:

Figure 1 is a front view of the cabinet of a refrigeration appliance in the form of a simple refrigerator and constructed according to the present invention, in which the cabinet is not provided with a freezing compartment and illustrated with the front door being open at 180°;

Figures 2-6 are front views of the cabinet of figure 1 housing therewithin a freezing compartment positioned in different heights and with its front door in the closed condition, said cabinet defining a combined refrigeration appliance;

Figure 7 is a view similar to those of figures 2-6, but illustrating the cabinet totally filled with modular freezing compartments, with the respective front doors closed, said cabinet operating only as a freezer;

Figures 8 and 9 are front views of the cabinet of figure 1, but operating as a combined refrigeration appliance, having a freezing compartment with a double modular height, respectively mounted in the upper and lower regions of the cabinet;

Figure 10 is a schematic median vertical cross-sectional view of a refrigeration appliance constructed according to the present invention and with its cabinet housing two freezing compartments;

Figure 11 is a view similar to that of figure 10, but illustrating the cabinet provided with a single freezing compartment medianly positioned and presenting a double modular height;

Figure 12 is a partial schematic cross-sectional view

of the cabinet of the present refrigeration appliance, illustrating a possible constructive arrangement for the outlet openings in the refrigerating and freezing air supply ducts;

5 Figure 13 is a schematic horizontal cross-sectional view of the air refrigerating chamber, illustrating the relative positioning of the evaporator, of a pair of fans and of the air inlet openings and the air outlet window of the ducts in which the forced air
10 flow circulates;

Figure 14 is a perspective view of a portion of a pair of air supply ducts, one being a refrigerating air supply duct and the other a freezing air supply duct, which are positioned side by side along the height of
15 an inner rear wall of the cabinet, illustrating an open refrigerating air outlet and the closed adjacent freezing air outlet; and

Figures 15 and 16 are schematic horizontal cross-sectional views of the pair of air supply ducts shown
20 in figure 14, illustrating a valve in two operational positions, the first position closing the respective freezing air outlet and opening the refrigerating air outlet and the inverted position being shown in the other figure.

25 Detailed Description of the Invention

As mentioned above, the present invention is directed to appliances in the form of simple or combined refrigerators and freezers, generally of domestic use and of the type comprising a generally
30 parallelepipedic single cabinet 10 formed from an internal box 11 usually made of injected plastic, a generally metallic external box 12, and a thermal insulating filler 13, such as expanded polyurethane, provided between the internal box 11 and the external
35 box 12.

The cabinet 10 has at least one front door 14, of adequate construction, provided or not with inner shelves 14a and which defines, internally, a refrigerating compartment RC which is designed jointly
5 with the refrigerating circuit of the appliance to operate in an adequate temperature required for food conservation and which is around 5°C.

The cabinet 10 further defines, internally and generally in its upper region, an air refrigerating
10 chamber 15 within which is mounted at least one evaporator 20, generally of the tube-fin type, and at least one fan 30. In the illustrated exemplary construction, the air refrigerating chamber 15 houses a single evaporator 20 horizontally disposed and which
15 is medianly divided into two portions 20a and 20b, each designed to refrigerate a respective forced air flow produced by a respective fan 30 mounted downstream the respective portion 20a, 20b of the evaporator 20. It should be understood that the
20 evaporator 20 might be constructed in two separate portions and that the assembly formed by the evaporator and fan might be also disposed in the vertical position.

The present refrigeration appliance further comprises
25 at least one refrigerating air supply duct 40 having an inlet opening 41 in communication with the air refrigerating chamber 15, downstream the fan 30 operatively associated with a portion 20a of the evaporator 20, in order to allow the formed
30 refrigerated air flow, which is forced to pass through the respective portion 20a of the evaporator 20 by action of the associated fan 30, to be conducted to the interior of the refrigerating air supply duct 40 extended along the height of the refrigerating
35 compartment RC, generally close to the rear wall of

the latter and presenting a plurality of outlet openings 42 defined in predetermined levels and through which the forced refrigerated air flow blown by the respective fan 30 can be selectively conducted to the interior of the refrigerating compartment RC in different heights of the latter. It should be understood that two or more refrigerating air supply ducts 40 could be provided mounted along the rear wall or along the lateral walls of the refrigerating compartment RC.

Accordingly, the refrigeration appliance further comprises at least one freezing air supply duct 50 having an inlet opening 51 in communication with the air refrigerating chamber 15, downstream a respective fan 30 operatively associated with a portion 20b of the evaporator 20. In the illustrated example, there is provided only one freezing air supply duct 50 provided close to the rear wall of the refrigerating compartment RC and extending along the height of the latter and presenting a plurality of outlet openings 52 disposed in predetermined levels and through which the forced refrigerated air flow blown by the respective fan 30 can be selectively conducted to the inside of respective freezing compartments FC, generally in the form of thermally insulated parallelepipedic boxes 60, each provided with a respective front door 61 and presenting at least one modular height pattern, so that said boxes can be removably fitted inside the cabinet 10, as illustrated in the drawings.

Each box 60 that defines a freezing compartment FC is dimensioned to be fitted inside the cabinet 10, in order to occupy a modular height of the refrigerating compartment RC corresponding to a integer fraction of the maximum height of the latter, maintaining with the

inner walls of the cabinet 10, which are defined by the internal box 11, a gap which is sufficient to allow the air to circulate between the parts defined by the internal box 11 and the front door 14 of the cabinet 10 and the boxes 60 that define the freezing compartments FC. As illustrated in figure 1, the refrigeration appliance can take the form of a simple refrigerator with a cabinet 10 defining, internally, only one corresponding refrigerating compartment RC, in which upper region the air refrigerating chamber 15 of the forced refrigerating system ("no-frost") is separately defined.

In this manner of assembling the refrigeration appliance, no box 60 is mounted in the interior of the cabinet 10, which therefore has no freezing compartments FC. In this case, the outlet openings 52 of the freezing air supply duct 50 should remain closed and/or the fan 30 that provides the respective forced freezing air flow should remain turned off, the closing of said outlet openings 52 being obtained by valves 70, as described below.

The forced refrigerating air flow which is fed to the refrigerating compartment RC is returned to the air refrigerating chamber 15, upstream the respective portion 20a of the evaporator 20, through at least one refrigerating air return duct 80 provided with at least one inlet window 81 opened to the interior of the refrigerating compartment RC, and with an outlet window 82 opened to the interior of the air refrigerating chamber 15. In the illustrated construction, the refrigerating air return duct 80 takes the form of an air passage provided through a dividing wall 18 located between the air refrigerating chamber 15 and the interior of the cabinet 10, said air passage being provided in the front upper region

of the cabinet 10, close to the front door 14. The forced refrigerating air flow which is fed to the refrigerating compartment RC is returned to the air refrigerating chamber 15 in an ascending path, close to the front door 14, reaching the refrigerating air return duct 80 and the air refrigerating chamber 15, in which it is refrigerated again upon passing through the respective portion 20a of the evaporator 20, to be re-conducted to the refrigerating compartment RC through the refrigerating air supply duct 40.

Figures 2-6 illustrate different mounting arrangements for the formation of a combined refrigerator, comprising a refrigerating compartment RC which is formed by the inner volume of the cabinet except by its portion which is occupied by a freezing compartment FC defined by said removable box 60 which is simply fitted inside the cabinet 10 in different positions selected along the height of the latter and which dispose the box 60 leveled with at least one outlet opening 52 of the freezing air supply duct 50. Each box 60 presents an air inlet hole 62 provided in a wall adjacent to the freezing air supply duct 50 and which is aligned with a respective outlet opening 52 of the latter, for allowing the freezing air flow to enter into the box 60 of the freezing compartment FC. Each outlet opening 52 aligned with an air inlet hole 62 of a box 60 of a freezing compartment FC has a respective valve 70 conducted to an open condition, while the outlet openings 42 of the refrigerating air supply duct 40, which are directed to the region of the refrigerating compartment RC occupied by a box 60 of a freezing compartment FC, have the respective valves 70 closed.

Each box 60 is further provided with at least one air outlet hole 63 which is aligned, upon the mounting of

the box 60, with a respective inlet window 91 of a respective freezing air return duct 90, having a plurality of inlet windows 91 opened to the interior of the cabinet 10 in different predetermined heights, 5 the freezing air return duct 90 being provided with an outlet window 92 opened to the interior of the air refrigerating chamber 15, upstream a respective portion 20b of the evaporator 20.

The inlet windows 91 of the freezing air return duct 10 90 are generally blocked by an obturator 95, generally in the form of a plug, which is removably provided to liberate the passage of the freezing air flow through said inlet windows 91. The inlet windows 91 directed to the interior of a refrigerating compartment RC are 15 blocked by respective obturators 95, so as to prevent the refrigerating air from returning to the region of the air refrigerating chamber 15 and of the evaporator 20 in which the freezing air flow circulates.

In the illustrated construction, a freezing air return 20 duct 90 is provided that is constructed along the height of one of the lateral walls of the cabinet 10, between its internal box 12 and external box 13 and further through a portion of the dividing wall 18 which separates the air refrigerating chamber 15 from 25 the interior of the refrigerating compartment RC, the inlet windows 91 being directed to the interior of one of the sides of the cabinet 10 through its internal box 11 so as to be closed by an obturator 95 or opened to the interior of a respective box 60 of a freezing 30 compartment FC through a respective air outlet hole 63 of said box 60.

In the illustrated construction, the appliance comprises a refrigerating air supply duct 40 and a freezing air supply duct 50 which are vertically 35 positioned side by side along the inner rear wall of

the cabinet 10, the respective outlet openings 42, 52 of both ducts being positioned in laterally adjacent pairs, each pair being provided with a single valve 70 constructed to close one of the openings of one pair and simultaneously open the other opening of the same pair.

In a preferred constructive form, the valve 70, generally in the form of an angular double gate, is actuated to one and to the other of its operational conditions, upon the mounting and removing operations of a respective freezing compartment FC in relation to the cabinet 10. The valves 70 are preferably and constantly forced by means of any spring (not illustrated) to the operational position in which they close the respective outlet openings 52 of the freezing air supply duct 50 and open the respective outlet openings 42 of the refrigerating air supply duct 40.

Figure 7 illustrates an assembly in which the cabinet 10 is totally filled with freezing compartments FC presenting equal dimensions, and in this case the refrigeration appliance operates only as a freezer, with the fan 30, which is responsible for the refrigerating air flow, being kept in a turn-off condition.

The freezing compartment FC illustrated in figures 2-7, 10 and 12 are in the form of a basic module whose height does not justify the provision of inner shelves. However, according to the illustrated figures 8, 9 and 11, the freezing compartment FC can be in the form of a double or even triple module, and in this case its box 60 presents a height which corresponds to two or three times that of the basic module. In this case, the module of higher height can be internally provided with shelves 65. On the other hand, the inner

space of the cabinet 10 not occupied by freezing compartments FC defines a respective refrigerating compartment RC which can be provided with shelves 19. For mounting the freezing compartments in the interior of the cabinet 10, the latter is provided, in its inner lateral walls, with means (not illustrated) in the form of railed supports, which allow the boxes 60 to slide like drawers or to be fitted in the selected position inside the cabinet. Similar systems can be used for supporting the shelves 19 of the refrigerating compartment RC.

The proposed construction, in which the boxes 60 of the freezing compartments FC maintain a gap in relation to the inner adjacent walls of the cabinet 10, said boxes 60 besides having thermally insulating walls are covered with a surrounding layer of cold air coming from the refrigerating compartment or compartments RC, making the freezing in the interior of the boxes 60 more efficient.

The present appliance can operate with a compressor C of fixed or variable capacity. In the cases in which a compressor of variable capacity is used, the control of the refrigerating capacity is made either by varying the rotation of the respective fan 30 or by varying the speed of the compressor C. If a compressor with fixed capacity is used, only the rotation of the fan is controlled.

While only some possible forms of carrying out the invention have been described and illustrated herein, it should be understood that changes in the form and relative positioning of the different component parts could be made, without departing from the concept defined in the claims which accompany the present description.